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Using Ada* to Implement the Operations Management System as a Community of Experts

ABSTRACT

This paper describes an architecture for the Space Station Operations Management System (OMS), consisting of a distributed expert system framework implemented in Ada. The motivation for such a scheme is based on the desire to integrate the very diverse elements of the OMS while taking maximum advantage of knowledge-based systems technology. This technology is needed not only to solve problems that are specific to various elements of the OMS, but also to help solve the problems of integration and evolutionary growth.

Part of the foundation work for an Ada-based distributed expert system was accomplished in the form of a proof-of-concept prototype for the KNOMES project (Knowledge-based Maintenance Expert System). This prototype successfully used concurrently active experts to accomplish monitoring and diagnosis for the Remote Manipulator System. We have named the basic concept of this software architecture ACTORS, for Ada Cognitive Task Organization Scheme. An individual ACTOR is a modular software unit which contains both standard data processing and artificial intelligence components.

The work accomplished in the KNOMES project and in similar efforts throughout the industry suggest that the maintenance task for Space Station can best be accomplished via a knowledge-based system approach. In addition, tasks such as planning and scheduling, as well as logistics management and payload activity management, may also benefit greatly from the use of knowledge-based reasoning in some form. Since all of the above applications form a subset of the complete OMS, it will therefore be necessary to include the potential for utilizing knowledge-based systems within the OMS -- if not at IOC, then during the growth of the station. In addition, it will be necessary for all of these OMS components to talk to each other.

It is when one considers the overall problem of integrating all of the OMS elements into a cooperative system that the AI solution stands out. By utilizing a distributed knowledge-based system as the framework for OMS, it will be possible to integrate those components which need to share information in an intelligent manner. This will be particularly crucial where processes need to be controlled in a hierarchical manner. One example is where a maintenance system for a particular subsystem needs to inform the scheduler about new constraints on the activities which that subsystem can perform.

* Ada is a trademark of the U.S. Government, (Ada Joint Program Office)

Finally, there remains the question of implementing such a system within the confines of Ada. The proof that this can be done rests on the KNOMES prototype's use of ACTORS, on past implementations of AI languages using more traditional languages (eg., OPS-5 using BLISS), and on the implementation of a major commercial knowledge-based system environment in C. In fact, without the benefits of object-oriented programming as implemented in Ada, or the integration afforded by Ada's development constructs, the task for implementing a distributed knowledge-based system for OMS would be considerably more difficult.

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